

NPD γ : A Precision Measurement of the Parity-Violating Gamma Asymmetry in the Capture of Polarized Cold Neutrons by Para-Hydrogen

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The NPD γ experiment intends to measure the parity-violating γ -asymmetry (A_γ) with respect to the neutron spin in the capture of cold polarized neutrons on para-hydrogen, $\bar{n} + p \rightarrow d + \gamma$, with a relative precision of 10^{-8} . In the meson exchange model of the weak nucleon-nucleon interaction, the long range potential is determined by the lightest meson, the pion. The π -nucleon-nucleon coupling constant H_π^1 is the dominant contributor to A_γ .



FIG. 1: The experimental setup in the LANSCE flight path 12 area. An Al frame holds the 4 magnet coils in a double Helmholtz configuration. The CsI-detector array and ^3He spin-flipper are visible inside the frame.

In 2003 construction of the experimental cave was finished and all parts of the experiment were installed at the Los Alamos Neutron Science Center (LANSCE).

Berkeley was responsible for building a double Helmholtz guide coil system which preserves the neutron's spin during its flight from the polarizer to the target. This is accomplished by application of a constant 10 Gauss magnetic field with a gradient of less than 1 mGauss/cm along the beam line.

Three-axis flux gate magnetometers are used for field monitoring. Fig.2 shows that the field – measured along the beam axis after the initial installation – fulfills the design requirements with respect to the field gradient. A few field-distorting parts of the setup were identified and are being improved. The

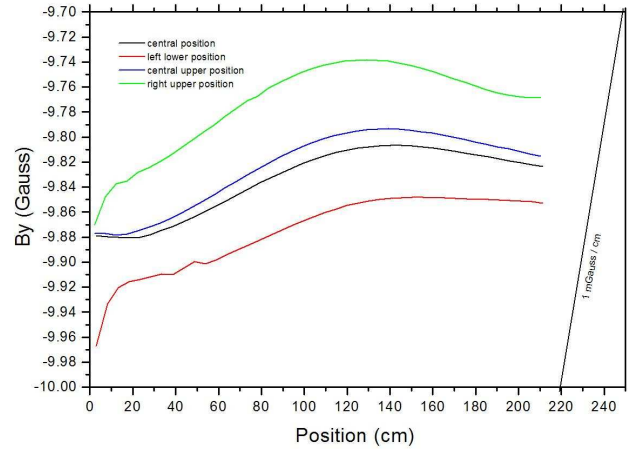


FIG. 2: Measured field along the beam axis in 4 different positions in and off center. The line on the right visualizes the allowed 1mGauss/cm gradient.

long-term stability of the main coil power supply, running on 23 Amps, is on the few ppm level and is directly reflected in the high stability of the field.

From February to April 2004 the first cold neutron beam entered the NPD γ cave, allowing us to commission the guide coils, the ^3He spin-polarizer, the RF spin-flipper, and the 48 γ -detectors. We also measured the γ -asymmetry following neutron capture in Al to be a few times 10^{-7} . This is important, since Al is the primary target material and will contribute $\sim 10\%$ to A_γ . Effects from Cu, In, B, Cl and Rh were also measured since these materials are present in the final setup.

The liquid hydrogen target was set up and tested, and awaits safety commissioning this summer.

Production data taking is foreseen for 2004.

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